MAMMATO-CUMULUS CLOUDS AND THUNDERSTORM AT BINGHAMTON, N. Y., JUNE 24, 1914.

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Soon after 6 o'clock in the afternoon of June 24, 1914, the typical thunderstorm cloud formation appeared in the west, and by 6:30 p. m. the sky was overcast with boiling storm clouds. From 6:30 p. m. to 6:45 p. m. a light shower occurred, the rain drops being large and widely spaced. The splash made by each drop was about 2 inches in diameter. The first thunder was heard at 6:20 p. m. and occasional peals of thunder continued until 7:58 p. m. At 6:55 rain set in again, accompanied at 7:05 p. m. by a wind velocity of 34 miles per hour from the west for three or four minutes. The rainfall became excessive at 7:08 p. m. and continued excessive until 7:18 p. m., when it became light again and ended at 7:40 p. m. The total rainfall was 0.82 inch and during the 10 minutes ending at 7:18 p. m. an estimated amount of 0.60 inch fell.

The sun broke through the clouds on the western horizon at 7:25 p. m. and a double rainbow appeared in the east. There were at that time no mammato-cumulus clouds visible. At 7:38 p. m. the sun had set (astronomical sunset 7:43) and mammato-cumulus clouds were just beginning to become visible on the western edge of what then appeared to be a stretch of alto-stratus clouds covering the sky from near the western horizon eastward until it mingled with the storm clouds then passing off in the east.

Fourteen photographs were taken in the interval from 7:40 p. m. to 7:55 p. m. (see figs. 1 and 2). During that time the visible mammato-cumulus formation increased until it covered the entire sky at 7:43 p. m., and a second thunderstorm made its appearance in the west, passed beneath the mammato-cumulus clouds, and at 7:56 p. m. was over and to the south of the observer.

The alto-stratus cloud layer in which the mammato-cumulus clouds formed was moving eastward at what seemed to be about half the velocity of movement of the second thunderstorm. In the southeast and south the alto-stratus layer seemed to merge into and become part of the storm cloud. The mammato-cumulus clouds first made their appearance at the western edge of the alto-stratus layer as downward bulges in the cloud film. The number of bulges increased toward the east until the sky was nearly covered. There was no evidence of rotary movement in any of the pouches. They seemed to be downward bulges in the cloud stratum and each pouch persisted for some time, appearing gradually and dissipating gradually. Under a few of the pouches in the early stages of the phenomenon there was a distinct veil following the outline of the pouch, such as a scarf cloud which sometimes appears over a rounded thunderhead. Overhead and in the east toward the close of the phenomenon there were both pouches and what appeared to be holes in the cloud stratum where pouches had been. The pouches were tinted pink from the twilight glow. The "holes" were a dark greenish blue. Both pouches and holes seemed quiescent, except for eastward movement, and the holes had the size and appearance of having been made by the dissolving away of some of the pouches. At the same time in the north, above the advancing storm clouds of the second thunderstorm, was observed (among the mammato-cumulus) a cloud wave of small extent that appeared as though a cross-section had been made of two adjacent pouches and the front section removed. That is, there was a downward hollow, a ridge, and then another downward hollow, the two downward curves being of the same size and shape as the cloud pouches of that portion of the sky. The section was as sharp and well defined as if cut with a knife. An attempt was made to photograph this but the light had failed so rapidly that a considerable under-exposure resulted.

There was a considerable and distinct stratum, except in the east and south, of cloud-free air between the mammato-cumulus clouds and the thunderhead clouds that passed beneath them. There was a strong contrast between the quiescence of the mammato-cumulus clouds and the quick "boiling" of the lower clouds.

At 7:56 p. m. the center of the second thunderstorm was in the hills south of the observer. Lightning emerged from this center, passed to the alto-stratus and mammato-cumulus cloud layer and spread through this in much the same manner as the spark from an electrical machine spreads over the surface of a glass plate. There were innumerable branches to each discharge and these branches had the appearance of running along the undersurface of the alto-stratus layer and of going behind and between the mammato-cumulus pouches. The sight was a remarkable one but was, unfortunately, too evanescent for a photograph to be obtained.

The barograph trace shows a rise at 7:05 p. m. of 0.15 inch, followed quickly by a fall of 0.10 inch and then a more gradual rise and fall of 0.05 inch. The temperature trace shows a fall of 20° at 7 p. m. to 65° F., followed by a gradual rise to 69° by 9 p. m. The (surface) wind velocity was but 3 miles per hour from 6:25 p. m. to 6:45 p. m.; increased to 34 miles per hour at 7:05 p. m., and diminished again to a little less than 3 miles per hour from 7:20 to 7:45 p. m. During the first thunderstorm the wind was mainly from the southwest, while during the mammato-cumulus cloud phenomenon the surface wind was mainly from the east and northeast and the upper wind from the west.

The photographs (figs. 1 and 2, enlarged in reproduction) were taken with an f. 4.5 lens of 75 mm. focus with exposures of one twenty-fifth to one thirty-fifth of a second. The photographs are unable to show the delicate (sunset) color shades and contrasts that added to the distinctness and beauty of the phenomenon.

(To face p. 397.)

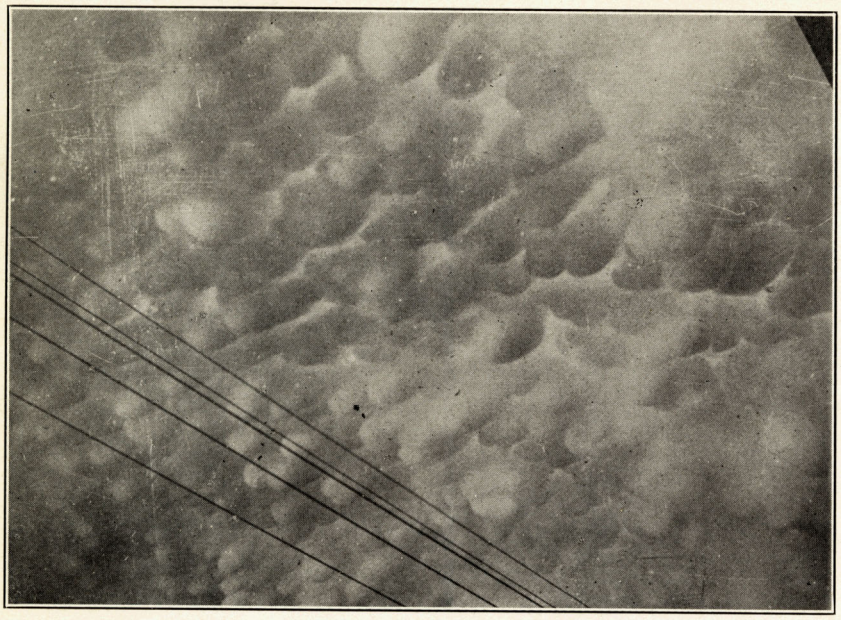

FIG. 1a.

FIG. 1b.

FIGS. 1a and 1b.—Mammato-cumulus formation associated with tornado. Photograph by L. C. Twiford, Bartlesville, Okla., June 15, 1912, 6:30 p. m.

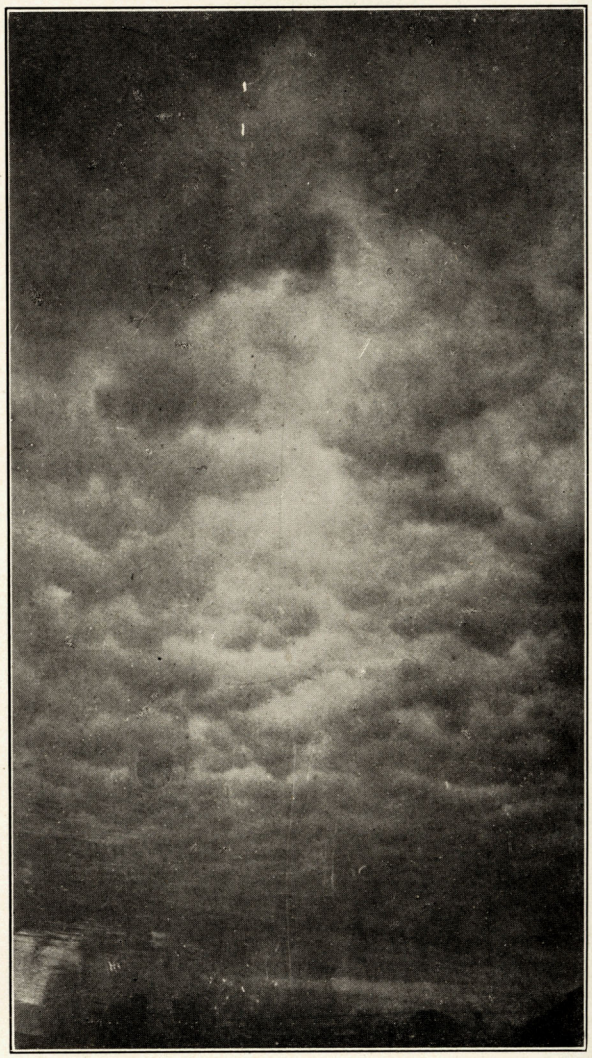

FIG. 2.—Mammato formation on under boundary of warm wind. Washington, D. C., Feb. 28, 1919, 7:10 a. m.

FIG. 3.—Mammillated squall cloud (G. A. Clarke).